WO 99/48189
PCT/EP99/01715

10

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:
MODIANO, Guido
Modiano & Associati
Via Meravigli, 16
I-20123 Milano
ITALIE

Date of mailing (day/month/year) 23 September 1999 (23.09.99)	
Applicant's or agent's file reference 32089/GM/1p	**IMPORTANT NOTICE**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/EP99/01715	16 March 1999 (16.03.99)	19 March 1998 (19.03.98)

Applicant
ASKOLL HOLDING S.R.L. et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   AU,CN,EP,IL,JP,KP,KR,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CU,CZ,DE,DK,EA,EE,ES,FI,GB,GD,GE,GH,GM,HR,
   HU,ID,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,
   SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZA,ZW
   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   23 September 1999 (23.09.99) under No. WO 99/48189

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, **a demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer
J. Zahra

Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

8

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

MODIANO, Guido
Modiano & Associati
Via Meravigli, 16
I-20123 Milan
ITALIE

Date of mailing (day/month/year) 04 May 1999 (04.05.99)	
Applicant's or agent's file reference 32089/GM/1p	**IMPORTANT NOTIFICATION**
International application No. PCT/EP99/01715	International filing date (day/month/year) 16 March 1999 (16.03.99)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 19 March 1998 (19.03.98)
Applicant ASKOLL HOLDING S.R.L. et al	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.

3. An **asterisk(*)** appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

4. The **letters "NR"** appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
19 Marc 1998 (19.03.98)	PD98A000058	IT	29 Apri 1999 (29.04.99)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

P. Regis

Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

(4)

From the RECEIVING OFFICE

PCT

NOTIFICATION OF THE INTERNATIONAL APPLICATION NUMBER AND OF THE INTERNATIONAL FILING DATE

(PCT Rule 20.5(c))

To:
Modiano, Guido
MODIANO & ASSOCIATI
Via Meravigli, 16
I-20123 Milano
ITALIE

Date of mailing *(day/month/year)* 7. 04. 99

Applicant's or agent's file reference
32089/GM/lp

IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP 99/01715	16/03/1999	19/03/1998

Applicant
ASKOLL HOLDING S.R.L

Title of the invention

1. The applicant is hereby notified that the international application has been accorded the international application number and the international filing date indicated above.
2. The applicant is further notified that the record copy of the international application was transmitted to the International Bureau on the above date of mailing.
3. ☒ Other: F. PCT/RO/106 A

* The International Bureau monitors the transmittal of the record copy by the receiving Office and will notify the applicant (with Form PCT/IB/301) of its receipt. Should the record copy not have been received by the expiration of 14 months from the priority date, the International Bureau will notify the applicant (Rule 22.1(c)).

Name and mailing address of the receiving Office
European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer
M. Legendre

Form PCT/RO/105 (0792) P20402

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No. PCT/EP 99/01715

International Filing Date 16 MAR 1999

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* 32089/GM/lp

Box No. I TITLE OF INVENTION

DEVICE FOR TRANSMITTING MOTION BETWEEN THE ROTOR OF A SYNCHRONOUS PERMANENT-MAGNET MOTOR AND THE WORKING PART, HAVING AN INCREASED FREE ROTATION ANGLE

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

ASKOLL HOLDING S.r.l.
Via Industria, 30
36031 DUEVILLE
ITALY

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

MARIONI Elio
Via Molino, 6
36031 DUEVILLE
ITALY

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

MODIANO Guido
MODIANO & ASSOCIATI
Via Meravigli, 16
20123 MILANO
ITALY

Telephone No.
(003902) 86.92.442

Facsimile No.
(003902) 86.38.60

Teleprinter No.

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

- ☒ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- ☒ AL Albania
- ☒ AM Armenia
- ☒ AT Austria
- ☒ AU Australia
- ☒ AZ Azerbaijan
- ☒ BA Bosnia and Herzegovina
- ☒ BB Barbados
- ☒ BG Bulgaria
- ☒ BR Brazil
- ☒ BY Belarus
- ☒ CA Canada
- ☒ CH and LI Switzerland and Liechtenstein
- ☒ CN China
- ☒ CU Cuba
- ☒ CZ Czech Republic
- ☒ DE Germany
- ☒ DK Denmark
- ☒ EE Estonia
- ☒ ES Spain
- ☒ FI Finland
- ☒ GB United Kingdom
- ☒ GD Grenada
- ☒ GE Georgia
- ☒ GH Ghana
- ☒ GM Gambia
- ☒ HR Croatia
- ☒ HU Hungary
- ☒ ID Indonesia
- ☒ IL Israel
- ☒ IN India
- ☒ IS Iceland
- ☒ JP Japan
- ☒ KE Kenya
- ☒ KG Kyrgyzstan
- ☒ KP Democratic People's Republic of Korea
- ☒ KR Republic of Korea
- ☒ KZ Kazakhstan
- ☒ LC Saint Lucia
- ☒ LK Sri Lanka
- ☒ LR Liberia
- ☒ LS Lesotho
- ☒ LT Lithuania
- ☒ LU Luxembourg
- ☒ LV Latvia
- ☒ MD Republic of Moldova
- ☒ MG Madagascar
- ☒ MK The former Yugoslav Republic of Macedonia
- ☒ MN Mongolia
- ☒ MW Malawi
- ☒ MX Mexico
- ☒ NO Norway
- ☒ NZ New Zealand
- ☒ PL Poland
- ☒ PT Portugal
- ☒ RO Romania
- ☒ RU Russian Federation
- ☒ SD Sudan
- ☒ SE Sweden
- ☒ SG Singapore
- ☒ SI Slovenia
- ☒ SK Slovakia
- ☒ SL Sierra Leone
- ☒ TJ Tajikistan
- ☒ TM Turkmenistan
- ☒ TR Turkey
- ☒ TT Trinidad and Tobago
- ☒ UA Ukraine
- ☒ UG Uganda
- ☒ US United States of America
- ☒ UZ Uzbekistan
- ☒ VN Viet Nam
- ☒ YU Yugoslavia
- ☒ ZW Zimbabwe

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

- ☒ ZA SOUTH AFRICA
- ☒ AE United Arab Emirates
- ☐

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application: regional Office	international application: receiving Office
item (1) 19 MARCH 1998 (19.3.1998)	PD98A000058	ITALY		
item (2)				
item (3)				

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): _____

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*

ISA /

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following **number of sheets**:

request	3
description (excluding sequence listing part)	15
claims	6
abstract	1
drawings	6
sequence listing part of description	
Total number of sheets	31

This international application is **accompanied** by the item(s) marked below:

1. ☐ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*:

Figure of the drawings which should accompany the abstract: 3

Language of filing of the international application: English

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Milano, Italy
March 12, 1999

MODIANO Guido

For receiving Office use only

1. Date of actual receipt of the purported international application:
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA /
6. ☐ Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

Copy for the Elected Office (EO/US) PCT/EP99/01915

PATENT COOPERATION TREATY

28x1
09/423544
2834

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

CIBA SPECIALTY CHEMICALS HOLDING, INC.
Patentabteilung
Klybeckstrasse 141
CH-4057 Basel
SUISSE

RECEIVED
AUG 14 2000
TC 2800 MAIL ROOM

Date of mailing (day/month/year) 24 July 2000 (24.07.00)	
Applicant's or agent's file reference LS/2-21518/A	**IMPORTANT NOTIFICATION**
International application No. PCT/EP99/01915	**International filing date** (day/month/year) 22 March 1999 (22.03.99)

1. The following indications appeared on record concerning:

[X] the applicant [X] the inventor [ ] the agent [ ] the common representative

Name and Address	State of Nationality	State of Residence
BURCKHARDT, Stefan Steinmattweg 16 CH-4143 Dornach Switzerland	CH	CH
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [ ] the nationality [ ] the residence

Name and Address	State of Nationality	State of Residence
BURCKHARDT, Stefan Gansacherweg 42 CH-4460 Gelterkinden Switzerland	CH	CH
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer G. Bähr
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/306 (March 1994) 003425846

PATENT COOPERATION TREATY

(9)

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

To:
MODIANO & ASSOCIATI
Attn. Modiano, Guido
Via Meravigli, 16
I-20123 Milano
ITALY

Date of mailing *(day/month/year)* 06/08/1999	
Applicant's or agent's file reference 32089/GM/lp	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/EP 99/ 01715	International filing date *(day/month/year)* 16/03/1999
Applicant ASKOLL HOLDING S.R.L. et al.	

1. [X] The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Fascimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. [ ] The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. [ ] **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

[ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

[ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Emilio Fontana Balparda

Form PCT/ISA/220 (July 1998)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
32089/GM/1p		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP 99/01715	16/03/1999	19/03/1998
Applicant		
ASKOLL HOLDING S.R.L. et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 3

   [X] as suggested by the applicant.

   [ ] None of the figures.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 99/01715

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H02K7/118 F16D3/02 F04D13/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H02K F16D F16H F04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 723 329 A (ASKOLL SRL) 24 July 1996 (1996-07-24) abstract column 4, line 15 - column 5, line 46	1-4,6, 12, 17-20,23
Y	FR 965 022 A (PIERRE-JULES-LOUIS JULLIEN) 31 August 1950 (1950-08-31) figures	1-3,6
Y	US 4 803 855 A (KENNEDY WILLIAM L) 14 February 1989 (1989-02-14) column 2, line 25 - column 3, line 11	1,2,4,12
Y	US 1 627 964 A (ROBERT M GALLOWAY) 10 May 1927 (1927-05-10) claims 1,2	1,2, 17-20,23

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 July 1999	06/08/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Ramos, H

Form PCT/ISA/210 (second sheet) (July 1992)

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(71) Applicant *(for all designated States except US)*: ASKOLL HOLDING S.R.L. [IT/IT]; Via Industria, 30, I–36031 Dueville (IT).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: MARIONI, Elio [IT/IT]; Via Molino, 6, I–36031 Dueville (IT).

(74) Agent: MODIANO, Guido; Modiano & Associati, Via Meravigli, 16, I–20123 Milano (IT).

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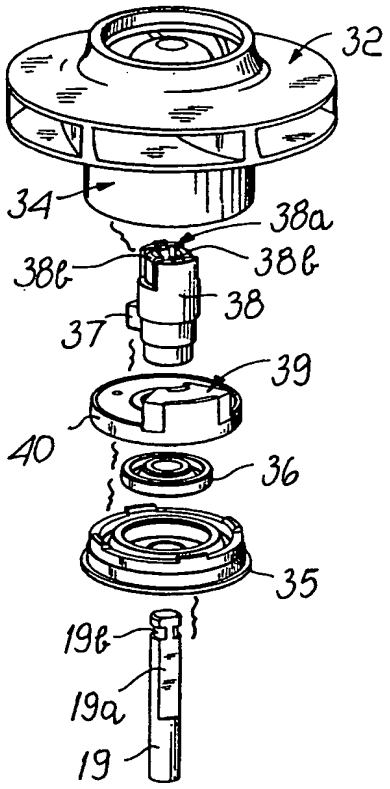
(57) Abstract

A device for tranmitting motion between the rotor of a synchronous permanent–magnet motor and the working part, having an increased free rotation angle, which comprises at least two motion transmission couplings which mutually cooperate in a kinematic series. Each coupling is constituted by at least one driving element (37) which is eccentric with respect to the rotation axis and is rigidly coupled to a first component (14) of the motion transmission system and by at least one driven element (39, 41), which is also eccentric with respect to the rotation axis and is rigidly coupled to the component (32) arranged kinematically after the preceding one. The angle covered by the elements of each coupling is, as a whole, less than a round angle. The intermediate components of the kinematic transmission have both a driven element (39, 41) and a driving element (37) for receiving the motion from the preceding one and transmitting it to a subsequent one.



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DEVICE FOR TRANSMITTING MOTION BETWEEN THE ROTOR OF A SYNCHRONOUS PERMANENT-MAGNET MOTOR AND THE WORKING PART, HAVING AN INCREASED FREE ROTATION ANGLE

Technical field

The present invention relates to a device for transmitting motion between the rotor of a synchronous permanent-magnet motor and the working part having an increased free rotation angle.

Background art

It is known that electric motors with permanent-magnet rotor have a structural layout which includes a stator, with an electromagnet constituted by a lamination pack and by associated windings, and a rotor which is arranged between two poles formed by the stator and is axially crossed by a shaft which is rotatably connected to a supporting structure.

It is also well-known that the higher the inertia of the load applied to a synchronous motor, the more difficult it is to start said motor.

Starting in fact occurs as a transient process in which the direction of rotation, the speed and the current change until synchronous operation is achieved.

During this transient process the rotor oscillates due to the alternating magnetic field produced by the stator, which by inducing a torque on the permanent-magnet rotor tends to move said rotor into a position in which the magnetic field of said rotor is aligned with the stator field.

If, during this hunting, the rotor acquires enough kinetic energy to move slightly out of its alignment position, it undergoes a further acceleration which makes it turn slightly further, and so forth, until synchronous operation is achieved.

For an equal power level, the extent of the oscillations produced in the rotor increases as the inertia of the applied load decreases; accordingly, the rotor is able to accelerate, acquiring a speed which allows it to synchronize with the alternating field of the stator.

If instead the inertia of the load is significant, the extent of the oscillation of the rotor is limited and synchronous operation cannot be achieved.

As the inertia of the load increases, the extreme situation occurs in which after power has been supplied to the stator the rotor cannot even begin its oscillation, i.e., it remains motionless in its equilibrium position.

When the inertia of the load is not too high with respect to the power of the motor (for example the impeller of a centrifugal pump), couplings of the mechanical type are currently widely used; said couplings are inserted between the load and the rotor and allow said rotor to oscillate freely, during starting, through a certain rotational angle.

This is the case of so-called toothed couplings, in which a first driving tooth is eccentric with respect to the rotation axis and is rigidly coupled to the rotor, while a second driven tooth is also eccentric with respect to the rotation axis and is rigidly coupled to the load.

In this manner, during the starting transient the rotor is disengaged from the inertia of the load and this makes it easier to achieve synchronous operation.

Accordingly, there is a free rotation through a certain angle (usually 180 sexagesimal degrees) followed by impact when the load is engaged, providing a direct connection between the load and the rotor, which are in practice rigidly coupled during operation.

Therefore the free rotation transient allows the motor to reach the synchronous state and to develop a torque which allows it to overcome the starting moment of inertia of the load.

After this starting transient, the torque, and therefore the power, required in the steady state is very often far lower than the static torque.

However, there are applications in which the moment of inertia of the load is so high (for example the impeller of a centrifugal pump used as a washing pump in dishwashers) that even the above mentioned couplings are unable to start it unless the motor is oversized to the point of being excessively expensive to manufacture and use and is therefore of no interest for the user.

As the inertia and resisting torques increase, the generated static torque must in fact also increase, with the obvious limits posed by the maximum stator flux

allowed by permanent magnets, on penalty of demagnetizing them, and by the ability of the active components (iron and copper) to dissipate the temperatures generated due to the high circulating currents that occur even after the transient starting step has ended.

A further consequence is the high level of vibration generated due to the angular torque oscillations caused by a disproportionate choice of motor size in order to be able to produce the torque required for starting.

The effect of these oscillations, which are produced at every turn of the rotor, is to produce an instantaneous separation of the two teeth of the coupling, consequently generating noise.

The high static torque also makes it difficult to provide appropriate dimensions for the coupling owing to the intense stresses produced during impact and leads to the generation of excessive noise.

In such cases, it is thought that one solution for the initial driving of the load might be, apart from oversizing the motor, to increase the angle of free rotation of the rotor with respect to the load, i.e., to provide a greater uncoupling of the motor from the load during the starting transient.

This is currently constrained by the materials used for the parts of the coupling, particularly the teeth, which are usually made of plastics, as well as by the radial dimensions of the rotor, which are necessarily modest (on the order of a few tens of millimeters), bearing in mind that the impact of one tooth against the other during starting is considerable.

The interposition of shock-absorbing means, which is sometimes provided, worsens the situation because said means also require their own angular extension and accordingly their presence further reduces the available free rotation angle.

It is also known that synchronous permanent-magnet motors are bidirectional; i.e., at power-on the rotor can equally start turning clockwise or counterclockwise.

While this is not a problem in the case of the actuation of centrifugal pumps with radial vanes, it is a considerable limitation for centrifugal pumps which have a particular vane configuration and accordingly a single direction of rotation for

the impeller.

Disclosure of the Invention

The aim of the present invention is to provide a device for transmitting motion between the rotor of a synchronous permanent-magnet motor and the working part which increases the angle of freedom that can be provided at present.

Within the scope of this aim, a consequent primary object is to reduce the power level that is currently required in a permanent-magnet motor for starting because of the above-mentioned problems, bringing it closer to the power level absorbed in steady-state operation and therefore reducing the oversizing required for example to start loads having a particularly high inertia.

Another important object is to ensure that the power absorbed by the load in one direction of rotation is higher than the power that can be generated by the motor and that said power absorbed in the opposite direction of rotation is lower than said power that can be developed, achieving loss of synchronization or pitch, blocking and automatic reversal in the first of said directions of rotation and achieving driving in the opposite direction of rotation, thus determining a single direction of rotation.

Another object is to provide a device for transmitting motion which is constructively simple and compact.

Another object is to provide a device for transmitting motion which is silent when starting and during operation.

Another object is to provide a motor which as a whole has a low consumption and a low cost.

This aim, these objects and others which will become apparent hereinafter are achieved by a device for transmitting motion between the rotor of a synchronous permanent-magnet motor and the working part, characterized in that it comprises at least two motion transmission couplings which mutually cooperate in a kinematic series, each coupling being constituted by at least one driving element which is eccentric with respect to the rotation axis and is rigidly coupled to a component of the motion transmission system and by at least one driven element, which is also

eccentric with respect to the rotation axis and is rigidly coupled to the component arranged kinematically after the preceding one, the angle covered by the elements of each coupling being, as a whole, less than a round angle, the intermediate components of the kinematic transmission having both a driven element and a driving element for receiving the motion from a preceding one and transmitting it to a subsequent one.

Advantageously, said motion transmission couplings are toothed, each coupling being constituted by at least one driving tooth, which is eccentric with respect to the rotation axis and is rigidly coupled to a component of the motion transmission system, and by at least one driven tooth, which is also eccentric with respect to the rotation axis and is rigidly coupled to the component arranged kinematically after the preceding one.

Brief description of the drawings

Further characteristics and advantages of the invention will become apparent from the following detailed description of an embodiment thereof, illustrated by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a sectional view of a permanent-magnet electric motor coupled to a centrifugal pump by means of a device according to the invention in a first embodiment;

Figure 2 is an axial sectional view of the rotor, of the device and of the impeller of Figure 1;

Figure 3 is an exploded perspective view of the device of the preceding figures;

Figure 4 is a transverse sectional view of the device of the preceding figures;

Figure 5 is an enlarged-scale axial sectional view of the device, taken along a plane which is perpendicular of the plane of the sectional view of Figure 2;

Figure 6 is an axial sectional view of a rotor of a motor of the device according to the invention in a second embodiment and of an impeller of a centrifugal pump;

Figure 7 is an exploded perspective view of the device of Figure 6;

Figure 8 is a transverse sectional view of the device of Figure 6;

Figure 9 is an axial sectional view of a rotor of a motor of the device according

to the invention in a third embodiment and of an impeller of a centrifugal pump;

Figure 10 is an exploded perspective view of the device of Figure 9;

Figure 11 is a transverse sectional view of the device of Figure 9;

Figure 12 is an axial sectional view of a rotor of a motor of the device according to the invention in a fourth embodiment and of an impeller of a centrifugal pump;

Figure 13 is an exploded perspective view of the device of Figure 12;

Figure 14 is an axial sectional view of the device according to the invention in a fifth embodiment and of an impeller of a centrifugal pump;

Figure 15 is an exploded perspective view of the device and of the impeller of Figure 14;

Figure 16 is a transverse sectional view of the device of Figure 14.

Ways of carrying out the Invention

With reference to the above Figures 1 to 5, said figures illustrate a permanent-magnet electric motor, generally designated by the reference numeral 10, which comprises a stator 11, with a lamination pack 12 and windings (not shown), and a rotor 14, which is arranged between two poles formed by said lamination pack 12.

The rotor 14 is constituted by an annular cylindrical permanent magnet 16 whereon a plastic element 17 is overmolded, forming an internal shank 17a and end flanges 17b.

The rotor 14 accordingly has, as a whole, a cylindrical shape with an axial hole 18 in which a shaft 19 is rigidly inserted.

The shaft 19 is in turn supported by a cup-shaped element 20 (the chamber that contains the rotor 14) which belongs to a structure 21 for supporting the entire motor 10.

The cup-shaped element 20 contains the rotor 14, separating it from the stator 11.

The shaft 19 is rotatably coupled, in the vicinity of the shaped bottom 22 of the cup-shaped element 20, to a bushing 25.

The seat for an elastomeric ring 26 is formed between the bushing 25 and a

similar bushing 24 accommodated in the bottom 22.

Likewise, bushings 27 and 28 are arranged between a closure element 23 which is arranged at the opposite end, is fixed to the supporting structure 21 and is crossed by the shaft 19; said bushings form, between them, the seat for an elastomeric ring 29.

The bushing 28 is axially crossed by the shaft 19, which can rotate therein.

A thrust bearing, generally designated by the reference numeral 30, is arranged between the bushing 28 and the corresponding flange 17b.

According to the invention, between the rotor 14, and accordingly between the shaft 19 rigidly coupled thereto, and the working part, which in this case is constituted by an impeller 32 of a centrifugal pump generally designated by the reference numeral 33 and coupled to the electric motor 10, there is a motion transmission device which comprises, in this case, two motion transmission couplings which mutually cooperate in a kinematic series.

Advantageously, the motion transmission couplings are of the toothed type and comprise, in an axial hollow body 34 which protrudes from the impeller 32 toward the rotor 14 and is close by a cover 35 (preferably, but not necessarily, a hermetic seal is provided inside it, for example by gluing, gaskets, interference fit, ultrasonic welding, etcetera on the outer edge and an elastomeric lip-shaped ring 36 in the region where the shaft 19 passes), a first tooth 37 which protrudes from a tang 38 which is keyed to the end of the shaft 19.

The shaft 19 in fact has, on its end, two diametrically opposite flat regions 19a by means of which it couples to a complementarily shaped hole 38a of the tang 38.

Axial fixing is achieved by means of elastic hooks 38b of the tang 38 which enter an annular groove 19b of the shaft 19.

The first tooth 37 is arranged eccentrically with respect to the shaft 19, has a limited radial extension and constitutes a driving tooth for a second tooth 39 which protrudes axially from an annular element 40 which can rotate freely in the hollow body 34 with respect to the shaft 19 and to said hollow body 34.

The second tooth 39 is composed of an internal supporting part 39a made of

rigid plastics and of two mutually opposite external parts 39b which are overmolded on the preceding one, are made of elastomer and form the contact surfaces.

The second tooth 39 might of course also be provided monolithically without overmolding, using for example a hard elastomeric material.

The radial extension of the second tooth 39 affects all of the region between the tang 38 and the outer wall of the hollow body 34, providing of course clearances which allow free movement or providing a slight interference (achieving a friction engagement) for example with a circumferential elastomeric element, not shown.

The second tooth 39 has an axial extension which allows it to make contact with the first tooth 37 and with a third tooth 41 which protrudes radially from the internal wall of the hollow body 34 to the vicinity of the external profile of the first tooth 37.

The second tooth 39 is therefore a tooth which is driven by the first tooth 37 and drives the third tooth 41, interacting therewith through the elastomeric parts 39b.

The angle covered by the assembly constituted by the first tooth 37 and by the second tooth 39 is smaller than a round angle and so is the angle covered by the assembly constituted by the second tooth 39 and by the third tooth 41.

When the electric motor 10 is actuated and the rotor 14 begins its rotation, the first tooth 37, i.e., the tooth that is rigidly coupled thereto, starts to rotate; during its rotation it encounters the second tooth 39 and moves it.

Said second tooth, being moved, then encounters the third tooth 41 and therefore at this point the impeller 32, which is monolithic therewith, is turned.

Conveniently, it is possible to introduce in the hollow body 34 a fluid having an adequate viscosity with lubricating, impact-damping and noise-deadening functions.

The motion transmission device is thus composed of two couplings which mutually cooperate in a kinematic series; a first one of said couplings is constituted by a driving element, which is eccentric with respect to the rotation axis (the first

tooth 37) and is rigidly coupled to a component of the motion transmission system (the rotor 14), and by a driven element (the second tooth 39 with the corresponding part 39b), which is also eccentric with respect to the rotation axis and is rigidly coupled to the component arranged kinematically after the preceding one (the annular element 40).

A second one of these couplings is composed of a driving element (the second tooth 39 with one of its parts 39b), which is rigidly coupled to a component of the motion transmission system (the annular element 40), and of a driven element (the third tooth 41), which is rigidly coupled to the component of the motion transmission system that is arranged kinematically to follow (the impeller 32).

In practice it has been observed that coupling in a kinematic series two toothed motion transmission couplings increases the angle of freedom between the rotor and the working part (in this case, the impeller) that can currently be provided, and this has the beneficial effect of reducing the power currently required for starting in a permanent-magnet motor.

This advantage accordingly allows to reduce the oversizing that is currently necessary to start loads having a particularly high inertia, as in the described case of a centrifugal pump.

By designing the vanes of the impeller with a configuration which is not radial but has an adequate curvature, the power absorbed by the load (the impeller and the working fluid) in one direction of rotation (the direction in which the impeller has the lowest efficiency) is higher than the available power of the motor and is lower in the opposite direction of rotation (the direction in which the impeller has the highest efficiency).

In the first case, the impeller 32 loses its synchronization or pitch with respect to the rotor 14, blocks and then automatically reverses its motion, while normal driving occurs in the second case.

Accordingly, a unidirectional motor has thus been obtained without any electric/electronic or mechanical device.

With reference now to the above Figures 6 to 8, a second embodiment of the

motion transmission device has a shaft 119 which can rotate freely with respect to the rotor 114.

In this case, an axial tang 138 protrudes from the head flange 117b of the rotor 114 and has a first eccentric tooth 137 which has a limited radial extension.

The axial extension of the first tooth 137 is approximately half of the axial extension of the tang 138; an annular element 140 is arranged on the other half so that it can rotate freely, and a second tooth 139 protrudes from said annular element; the axial dimensions of said tooth allow it to make contact with the first tooth 137 and with a third tooth 141 which occupies the radial space outside the first tooth 137 and protrudes from another annular element 142 which is rigidly coupled to the shaft 119.

In this case also, the second tooth 139 has an internal supporting part 139a and two external parts 139b made of elastomeric material.

As an alternative, the second tooth 139 might be monolithic.

The impeller, now designated by the reference numeral 132, is rigidly coupled to a pin 143 which is keyed in an axial hole thereof; the pin in turn is keyed to the end of the shaft 119 which is inserted in a suitable hole 144 of said pin.

In this case also, the rotation of the rotor 114 sequentially produces the transmission of motion between the first tooth 137, the second tooth 139 and respectively the third tooth 141, which is rigidly coupled to the shaft 119, and with the impeller 132.

With reference now to the above Figures 9 to 11, a third embodiment of the motion transmission device again has, between the rotor 214, and consequently between the shaft 219 rigidly coupled thereto, and the working part, which in this case also is constituted by an impeller 232 of a centrifugal pump which is coupled to the electric motor, two toothed motion transmission couplings which comprise, in an axial hollow body 234 which is monolithic with the impeller 232 and, in this case, is closed hermetically by a cover 235 with a lip-shaped gasket 236, two first teeth 237 which protrude in diametrically opposite positions from a first annular element 238 which is keyed to the shaft 219.

The first teeth 237 are arranged eccentrically with respect to the shaft 219, have a limited radial extension and constitute driving teeth for two second teeth 239 which protrude axially from a second annular element 240 which can rotate freely in the hollow body 234 with respect to the shaft 219 and to said hollow body 234.

The second teeth 239 also are diametrically mutually opposite.

The first teeth 237 are arranged axially in offset positions and the second teeth 239 are shaped so as to have parts 239a which protrude radially so as to affect all of the region between the tang 238 and the external wall of the hollow body 234, providing of course clearances which allow free movement or providing slight interference, producing a friction engagement, for example with a circumferential elastomeric element, not shown.

The second teeth 239 have an axial extension which allows them to also make contact with two third teeth 241 which are also diametrically opposite and protrude radially from the internal wall of the hollow body 234 in axially offset positions.

The second teeth 239 are therefore teeth which are driven by the first teeth 237 and drive the third teeth 241.

In this case, the parts, and therefore the masses, that rotate are arranged symmetrically with respect to the shaft 219 and therefore rotation is balanced.

With reference now to the above Figures 12 and 13, a fourth embodiment of the motion transmission device has, between the shaft 319 and the working part, in this case also constituted by an impeller 332 of a centrifugal pump, four toothed motion transmission couplings which cooperate with each other in a kinematic series.

Advantageously, two motion transmission couplings are arranged in an axial hollow body 334 which protrudes from the impeller 332 toward the rotor 314 and is closed by a cover 335, preferably so that a hermetic seal is formed inside it and therefore for example by gluing or by means of the other methods already mentioned, on the outer rim, and a lip-shaped ring 336 in the region where the shaft 319 passes.

In the hollow body 314 there is therefore a first tooth 337 which protrudes from a tang 338 which is keyed to the end of the shaft 319.

The first tooth 337 is arranged eccentrically with respect to the shaft 319, has a limited radial extension and constitutes a driving tooth for a second tooth 339 which protrudes axially from an annular element 340 which can rotate freely in the hollow body 334 with respect to the shaft 319 of said hollow body 334.

The second tooth 339 is composed of an internal supporting part 339a made of rigid plastics and of two mutually opposite external parts 339b which are overmolded on the internal part, are made of elastomeric material, and form the contact surfaces.

In this case also it is possible to provide the second tooth 339 monolithically.

The radial extension of the second tooth 339 affects all of the region between the tang 338 and the external wall of the hollow body 334, providing of course clearances which allow free movement or providing a slight interference, producing a friction engagement, for example with a circumferential element made of elastomeric material, not shown.

The second tooth 339 has an axial extension which allows it to make contact with the first tooth 337 and with a third tooth 341 which protrudes radially from the internal wall of the hollow body 334 to the vicinity of the external profile of the first tooth 337.

The second tooth 339 is therefore a tooth which is driven by the first tooth 337 and drives the third tooth 341, interacting with them by means of the elastomeric parts 339b.

The angle covered by the assembly constituted by the first tooth 337 and the second tooth 339 is smaller than a round angle and so is the angle covered by the assembly constituted by the second tooth 339 and by the third tooth 341.

The motion transmission device, in this case, again has an axial tang 342 which protrudes from the head flange 317b of the rotor 314 and has a fourth eccentric tooth 343 which has a limited radial extension.

The axial extension of the fourth tooth 343 is approximately half of the axial extension of the tang 342; an annular element 344 is arranged on the other half so that it can rotate freely, and a fifth tooth 345 protrudes from it; the axial extension

of said fifth tooth is such that it can make contact with the fourth tooth 343 and with a sixth tooth 346 which occupies the radial space outside the fourth tooth 343 and protrudes from another annular element 347 which is rigidly coupled to the shaft 319.

The fifth tooth 345 has an internal supporting part and two external parts made of elastomeric material which are not shown in the figures.

In this case, the rotation of the rotor 314 produces, in sequence, the transmission of motion between the fourth tooth 343, the fifth tooth 345 and then the sixth tooth 346, which is rigidly coupled to the shaft 319.

The shaft begins its rotation and the first tooth 337, the one that is rigidly coupled thereto, then begins to rotate and encounters, in its rotation, the second tooth 339, moving it.

Said second tooth, being driven, then encounters the third tooth 341 and then at this point the impeller 332, which is monolithic with respect to said third tooth, is turned.

With reference to Figures 14, 15 and 16, a fifth embodiment of a motion transmission device has, between the shaft 419 and the working part, which in this configuration also is the impeller 432 of a centrifugal pump, two motion transmission couplings which mutually cooperate in a kinematic series.

In this case, said couplings are arranged inside an axial hollow body 434 which protrudes from the impeller 432 toward the rotor, which is not shown in the above figures for the sake of simplicity, and is closed by a cover 435.

Preferably, said cover 435 closes said hollow body 434 by gluing, ultrasonic welding, or other methods, so as to ensure hermetic tightness internally.

In the region where the shaft 419 passes through said cover 435 there is a lip-shaped ring 436 made of elastomeric material.

Inside the hollow body 434 there is a first tooth 437 which protrudes from a tang 438 which is keyed to the end of the shaft 419.

Said end in fact has two diametrically opposite flat regions 419a with which a complementarily shaped hole 438a of the tang 438 mates.

Said first tooth 437 is eccentric with respect to the shaft 419 and has a limited axial extension; it constitutes a driving tooth for a second tooth 439 which protrudes axially from an annular element 440 which can rotate freely, inside the hollow body 434, with respect to the shaft 419.

Said second tooth 439 has an internal supporting part 439a made of rigid plastics which is monolithic with the annular element 440, which in this case has a substantially cylindrical structure, and is embedded in the remaining part 439b made of elastomeric material, which is overmolded on the preceding one and forms the contact surfaces.

In this case also, said third tooth 439 might be provided monolithically.

The radial extension of said second tooth 439 affects all of the region between the tang 438 and the internal wall of the hollow body 434.

Clearances are of course provided which allow free motion or, as an alternative, there is a slight interference which produces friction engagement, for example by resorting to a circumferential element made of elastomeric material which is not shown for the sake of simplicity.

Said second tooth 439 has an axial extension which allows it to make contact with said first tooth 437 and with a third tooth, now designated by the reference numeral 441, which protrudes axially from said cover 435 from a position which is proximate to the outer profile of the face that is directed toward the inside of the hollow body 434.

In particular, the axial extension of said third tooth 441 is such that it can make contact only with the elastomeric external parts 439b of the second tooth 439 but cannot make contact with said first tooth 437.

Said second tooth 439 is accordingly driven by the first tooth 437 and in turn drives said third tooth 441 by means of the elastomeric parts 439b.

The angle covered by the assembly constituted by the first tooth 437 and by the second tooth 439 is less than a round angle and so is the angle covered by the second tooth 439 together with said third tooth 441.

When the motor is started, the first tooth 437 therefore starts to rotate rigidly

with the rotor until it encounters, during its rotation, the second tooth 439, which it moves.

Said second tooth therefore starts to rotate concordantly with the rotor until it encounters said third tooth 441, which is rigidly coupled to the hollow body 434 and accordingly to the impeller 432, which is therefore turned.

In practice it has been observed that in all its embodiments the invention has achieved the intended aim and objects.

The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept.

All the details may also be replaced with other technically equivalent elements.

In practice, the materials employed, so long as they are compatible with the contingent use, as well as the dimensions, may be any according to requirements.

The disclosures in Italian Patent Application No. PD98A000058 from which this application claims priority are incorporated herein by reference.

CLAIMS

1. A device for transmitting motion between the rotor (14,114,214,314) of a synchronous permanent-magnet motor (10) and the working part (32,132,232,332,432), characterized in that it comprises at least two motion transmission couplings (37,39,137,139,237,239,337,339,437,439) which mutually cooperate in a kinematic series, each coupling being constituted by at least one driving element (37,39,137,139,237,239,337,339,437,439) which is eccentric with respect to the rotation axis and is rigidly coupled to a component (14,114,214,314) of the motion transmission system and by at least one driven element (39,41,139,141,239,241,339,341,439,441), which is also eccentric with respect to the rotation axis and is rigidly coupled to the component (32,132,232,332,432) arranged kinematically after the preceding one, the angle covered by the elements of each coupling being, as a whole, less than a round angle, the intermediate components of the kinematic transmission having both a driven element and a driving element for receiving the motion from a preceding one and transmitting it to a subsequent one.

2. The device according to claim 1, characterized in that said motion transmission couplings are toothed, each coupling being constituted by at least one driving tooth (37,39,137,139,237,239), which is eccentric with respect to the rotation axis and is rigidly coupled to a component of the motion transmission system (14,114,214,314), and by at least one driven tooth (39,41,139,141,239,241,339,341,439,441), which is also eccentric with respect to the rotation axis and is rigidly coupled to the component (32,132,232,332,432) that kinematically follows the preceding one.

3. The device according to claim 2, characterized in that it is composed of two couplings which mutually cooperate in a kinematic series, a first one of said couplings being constituted by a first tooth (37,137) which is rigidly coupled to the rotor (14,114) of a motor and by a second tooth (39,139) which is rigidly coupled to an annular element (40,140) which can rotate freely with respect to said rotor

(14,114), a second one of said couplings being composed of said second tooth (39,139) and a third tooth (41,141) which is rigidly coupled to the working part (32,132).

4. The device according to claim 2, characterized in that it is composed of two couplings which mutually cooperate in a kinematic series, a first one of said couplings being constituted by two first teeth (237) which are rigidly coupled to the rotor (214) of a motor in diametrically opposite positions, and of two second teeth (237) which are rigidly coupled, likewise in diametrically opposite positions, to an annular element (238) which can rotate freely with respect to said rotor, a second one of said couplings being composed of said second teeth (239) and of two third teeth (241) which are also diametrically opposite and are rigidly coupled to the working part (232).

5. The device according to claim 2, characterized in that it is composed of four couplings which mutually cooperate in a kinematic series, a first one of said couplings being constituted by a first tooth (337) which is rigidly coupled to the free shaft (319) of a motor and of a second tooth (339) which is rigidly coupled to an annular element (340) which can rotate freely with respect to said free shaft (319), a second one of said couplings being composed of said second tooth (339) and of a third tooth (341) which is rigidly coupled to the working part (332), a third one of said couplings being composed of a fourth tooth (343) which is rigidly coupled to the rotor (314) of said motor and of a fifth tooth (345) which is rigidly coupled to an annular element (344) which moves freely with respect to said free axis, a fourth one of said couplings being composed of said fifth tooth (345) and of a sixth tooth (346) which is rigidly coupled to said free shaft (319).

6. The device according to claim 3, characterized in that said motion transmission couplings are arranged in an axial hollow body (34) which is rigidly coupled to said working part (32) and is closed by a cover (35).

7. The device according to claims 3 and 6, characterized in that said first tooth (37) protrudes from a tang (38) which is keyed on the end of said shaft (19), said first tooth (37) being arranged eccentrically with respect to said shaft (19) and

constituting a driving tooth for said second tooth (39) which protrudes axially from an annular element (40) which can rotate freely in said hollow body (34) with respect to said shaft (19) and to said hollow body (34), said second tooth (39) having an extension which allows it to make contact with said first tooth (37) and with said third tooth (41) which protrudes from the internal wall of the hollow body (34).

8. The device according to claim 7, characterized in that said first tooth (37) has a radial extension which partially affects the internal space of said hollow body (34), the radial extension of said second tooth (39) affecting the region between said tang (38) and the external wall of said hollow body (34), providing clearances which allow free movement, said second tooth (39) having an axial extension which allows it to make contact with said first tooth (37) and with said third tooth (41), said third tooth (41) protruding radially from the internal wall of said hollow body (34) to the vicinity of the external profile of said first tooth (37).

9. The device according to claim 3, characterized in that said motion transmission couplings comprise a first tooth (137) which is rigidly coupled to an axial tang (138) which protrudes from a tip flange (117b) of said rotor (114), said annular element (140) from which said second tooth (139) protrudes being arranged so as to surround said shaft (119) and so that it can rotate freely, the extension of said second tooth (139) being such that it can make contact with said first tooth (137) and with said third tooth (141) which protrudes from another annular element (142) which is rigidly coupled to said shaft (119).

10. The device according to claim 9, characterized in that the axial extension of said first tooth (137) partially affects the extension of said tang (138), the remaining part being affected by said annular element (140), from which said second tooth (139) protrudes.

11. The device according to claim 9, characterized in that said third tooth (141) occupies the radial space provided externally with respect to said first tooth (137).

12. The device according to claim 4, characterized in that said couplings are arranged in an axial hollow body (234) which is rigidly coupled to said working

part (232) and is closed hermetically by a cover (235).

13. The device according to claims 4 and 12, characterized in that said two first teeth (237) protrude in a diametrically mutually opposite configuration from a first annular element (238) which is keyed to the shaft (219) of a motor, said first teeth (237) radially and partially affecting the space inside said hollow body (234), said first teeth (237) constituting driving teeth for said two second teeth (239) which protrude axially from a second annular element (240) which can rotate freely in said hollow body (234) with respect to said shaft (219) and to said hollow body (234), said second teeth (239) having an extension which allows them to make contact also with two third teeth (241) which protrude radially from the internal wall of said hollow body (234) in the region left free by said first teeth (237).

14. The device according to claim 13, characterized in that said first teeth (237) are arranged in axially offset positions and in that said second teeth (239) are shaped so as to have parts whose radial extension affects all of the region between said tang (238) and the external wall of the hollow body (234), providing clearances which allow free movement, said second teeth (239) having an axial extension which allows them to make contact with said first teeth (237) and with said third teeth (241) which protrude radially from the internal wall of said hollow (234) in axially offset positions.

15. The device according to claim 5, characterized in that two of said four motion transmission couplings are arranged in an axial hollow body (334) which protrudes from said working part toward said rotor and is closed by a cover (335).

16. The device according to claims 5 and 15, characterized in that said first tooth protrudes from a tang which is keyed to the end of said free shaft, said first tooth (337) being arranged eccentrically with respect to said shaft (319) and constituting a driving tooth for said second tooth (339) which protrudes axially from an annular element (340) which can rotate freely in said hollow body (334) with respect to said shaft (319) and said hollow body (334), said second tooth (339) having an extension which allows it to make contact with said first tooth (337) and with said third tooth (341) which protrudes from the internal wall of the

hollow body (334), the other two of said four motion transmission couplings comprising said fourth tooth (343), which is rigidly coupled to an axial tang (342) which protrudes from a tip flange (317b) of the rotor (314) of said motor, so as to surround said free shaft (319), said annular element (344) from which said fifth tooth (345) protrudes being arranged so that it can rotate freely, the extension of said fifth tooth (345) being such that it can make contact with said fourth tooth (343) and with said sixth tooth (346) which protrudes from another annular element (347) which is rigidly coupled to said shaft (319).

17. The device according to one or more of the preceding claims, characterized in that at least one of said teeth (39) is composed of an internal supporting part (39a) which is made of rigid plastics and of two mutually opposite external parts (39b) which are overmolded on the internal part (39a), are made of elastomeric material, and form the surfaces for contact with the other teeth.

18. The device according to one or more of the preceding claims, characterized in that said cover (35,335) closes said hollow body (347,334) so that a hermetic seal is provided therein.

19. The device according to one or more of the preceding claims, characterized in that a slight interference is provided between the mutually moving parts, producing a friction engagement.

20. The device according to one or more of the preceding claims, characterized in that in said hollow body (34,334) there is a viscous fluid which has lubricating, impact-damping and noise-deadening functions.

21. The device according to claims 3 and 6, characterized in that said first tooth (37) protrudes from a tang (38) which is keyed to the end of said shaft (19), said first tooth (37) being arranged eccentrically with respect to said shaft (19) and constituting a driving tooth for said second tooth (39) which protrudes axially from an annular element (40) which can rotate freely in said hollow body (34) with respect to said shaft (19) and to said hollow body (34), said second tooth (39) having an extension which allows it to make contact with said first tooth (37) and with said third tooth (41) which protrudes from the face of said cover (35) which is

directed toward the inside of the hollow body (34).

22. The device according to claim 21, characterized in that said first tooth (37) has a radial extension which partially affects the internal space of said hollow body (34), the radial extension of said second tooth (39) affecting the region between said tang (38) and the external wall of said hollow body (34), providing clearances which allow free movement, said second tooth (39) having an axial extension which allows it to make contact with said first tooth (37) and with said third tooth (41), said third tooth (41) protruding radially from a position which is proximate to the external profile of the cover (35) to the vicinity of the external profile of said annular element (40).

23. The device according to one or more of the preceding claims, characterized in that said working part is an impeller (32,132,232,332,432) with curved vanes of a centrifugal pump.

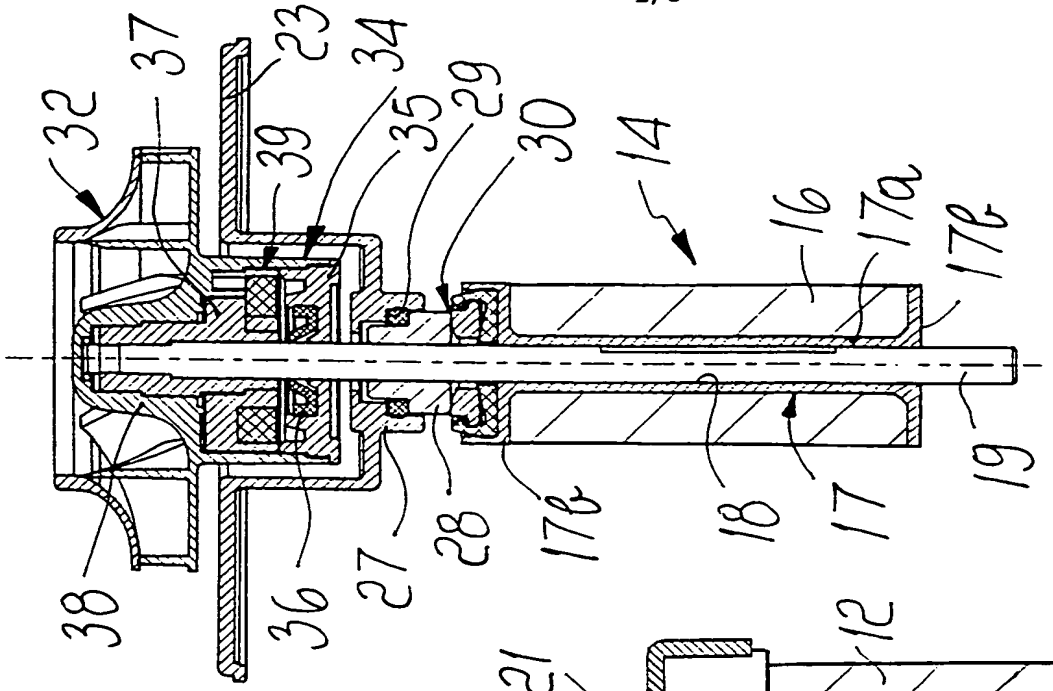
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Fig. 2

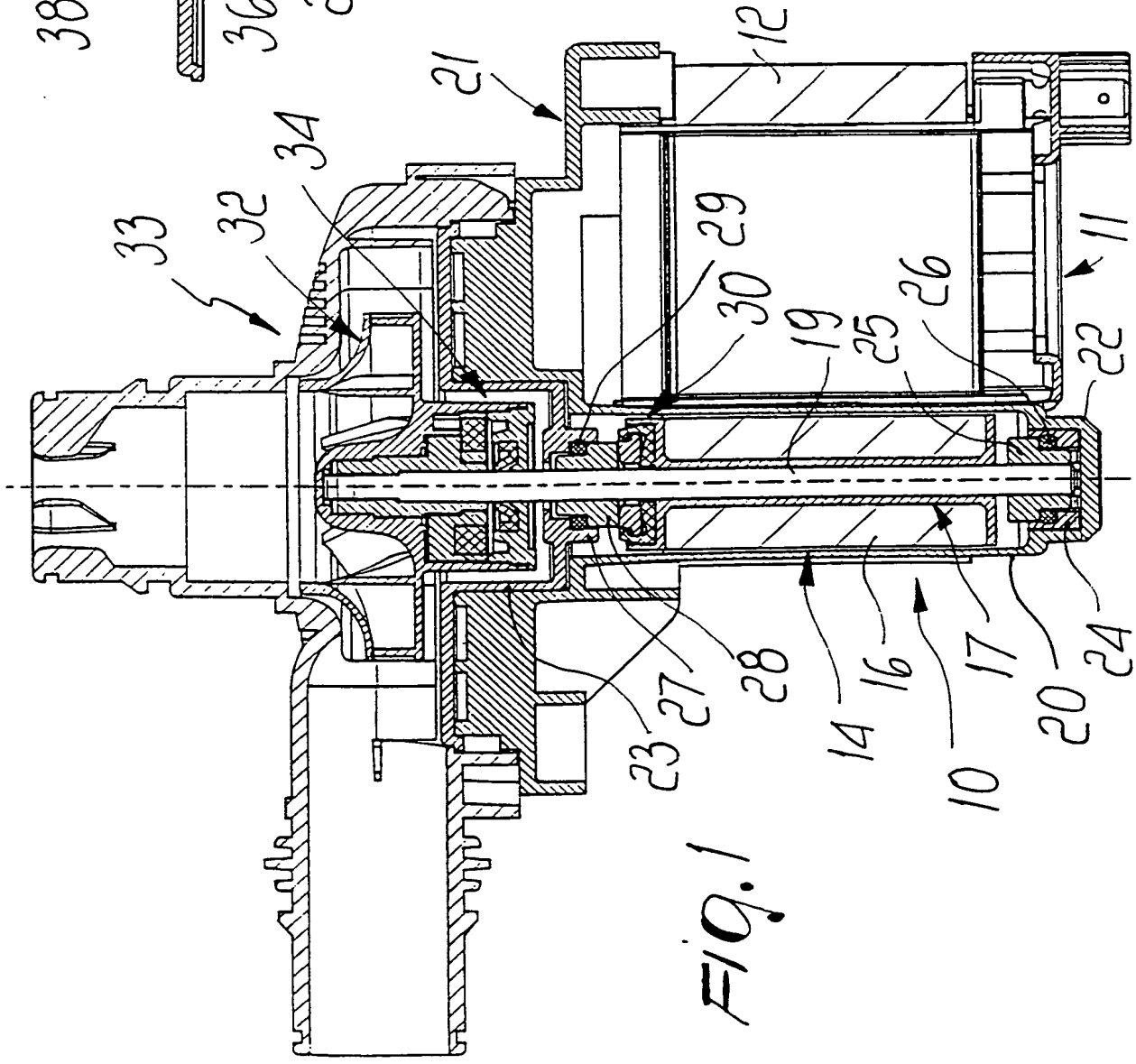
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Fig. 1

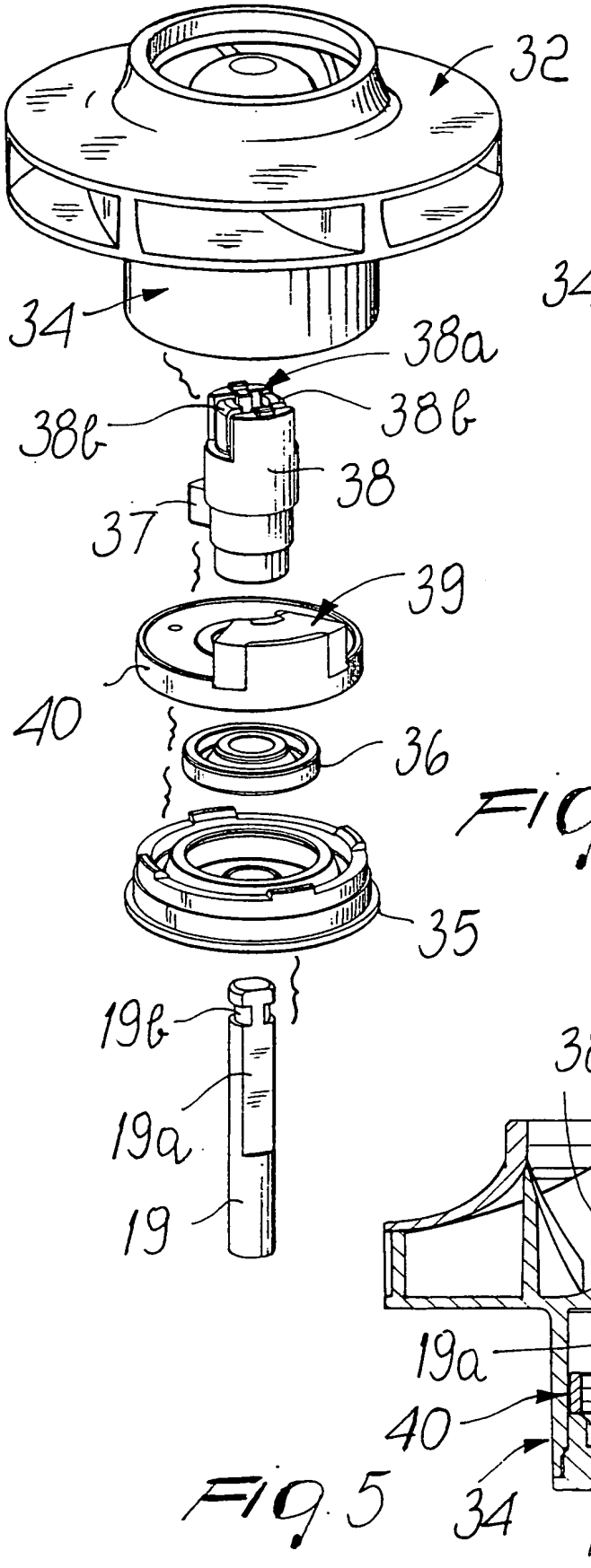

FIG. 3

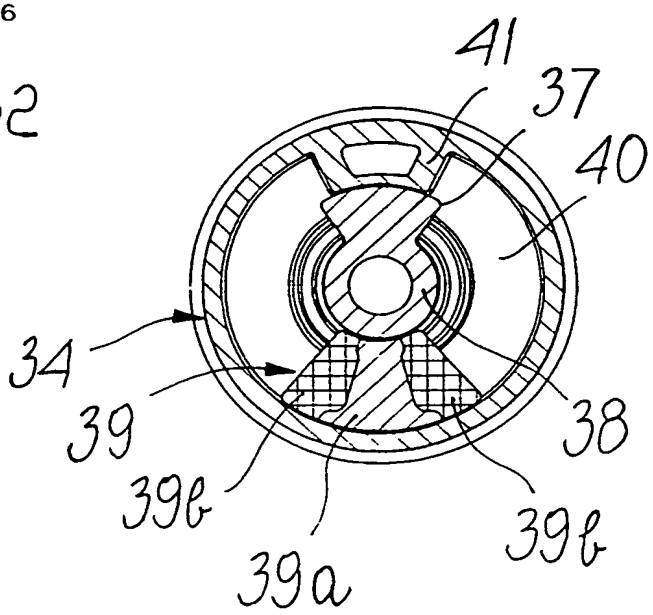

FIG. 4

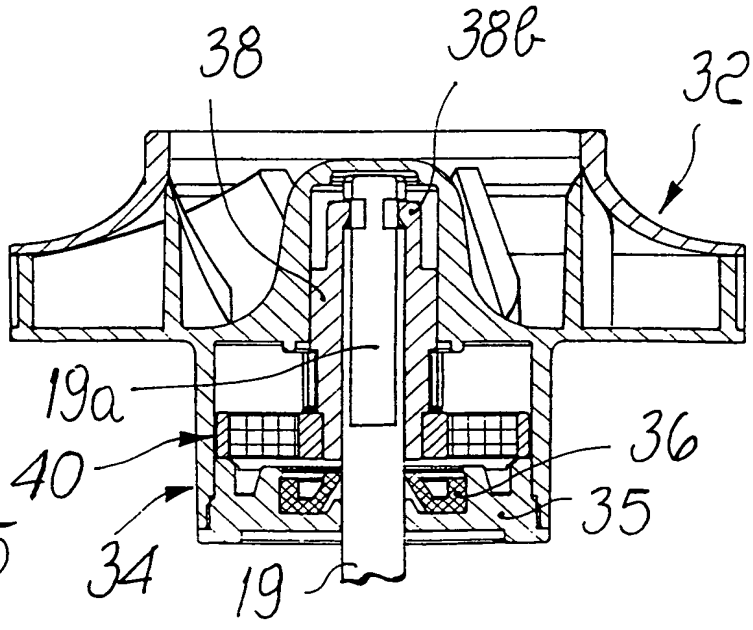

FIG. 5

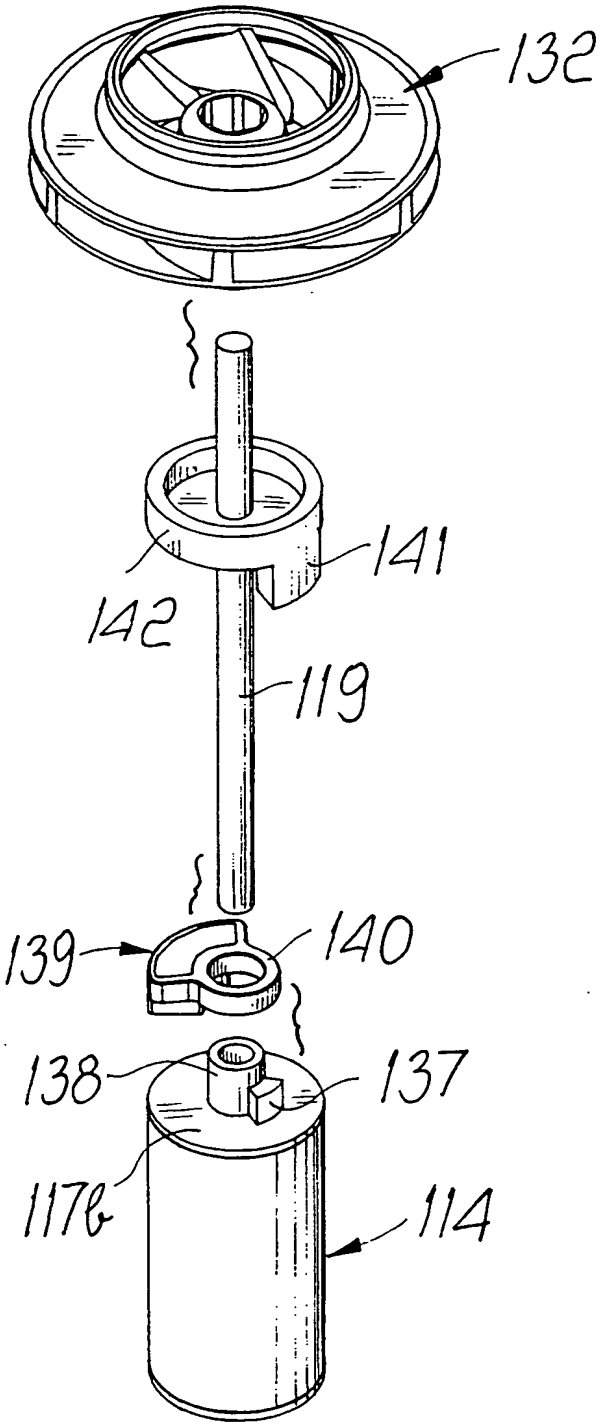

Fig. 7

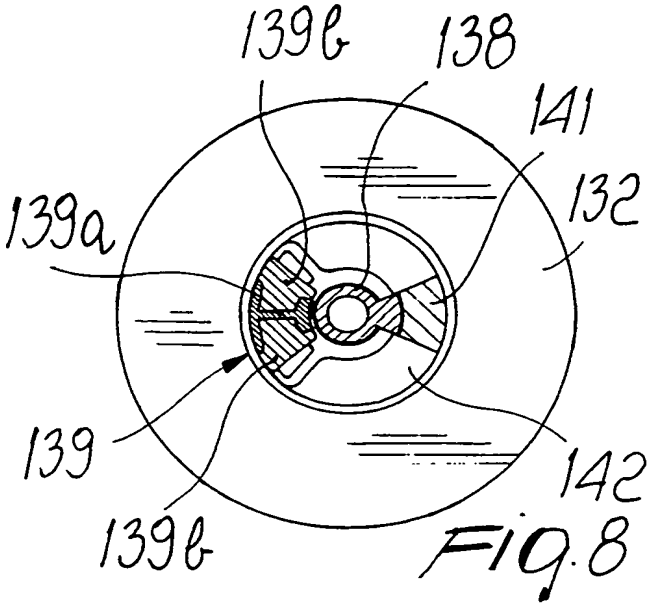

Fig. 8

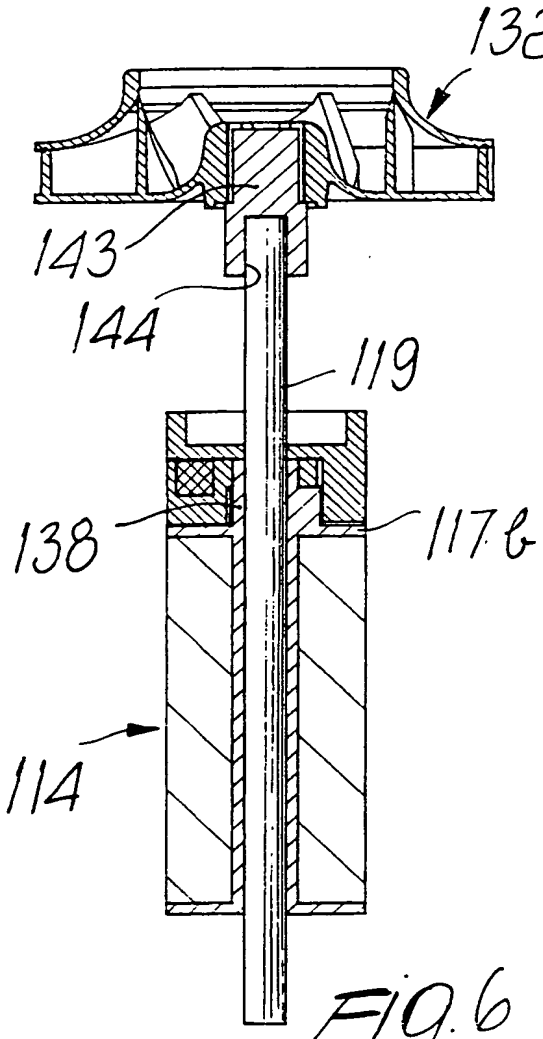

Fig. 6

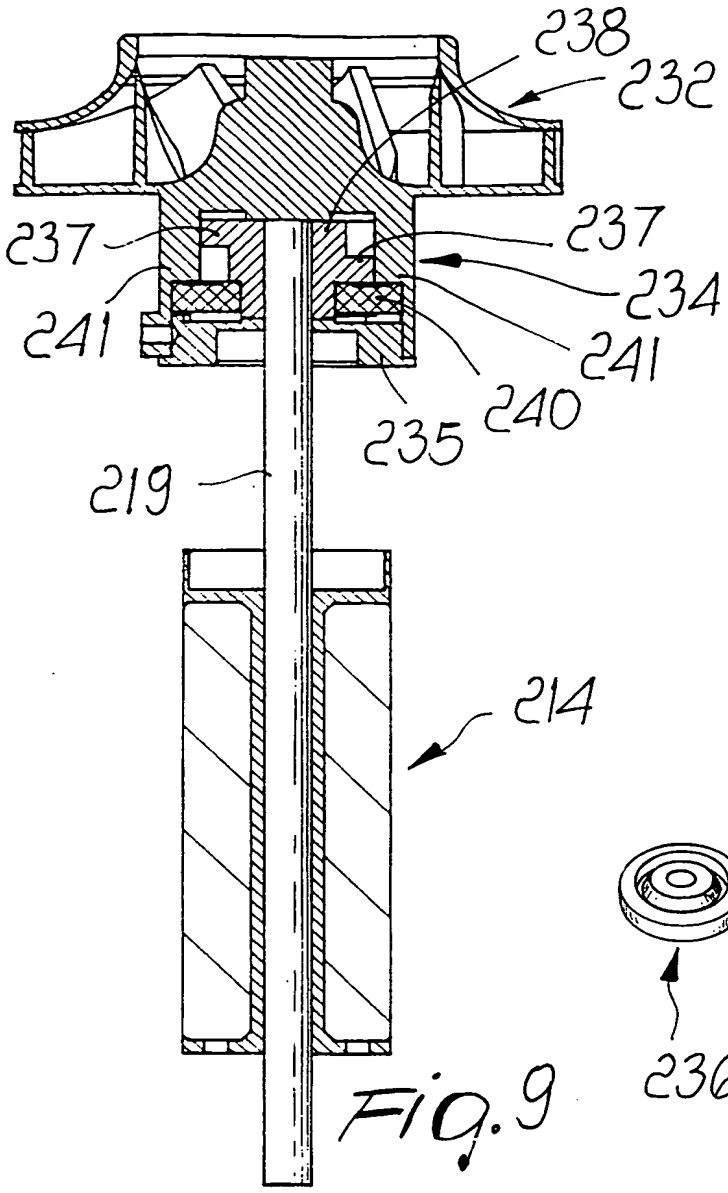

Fig. 9

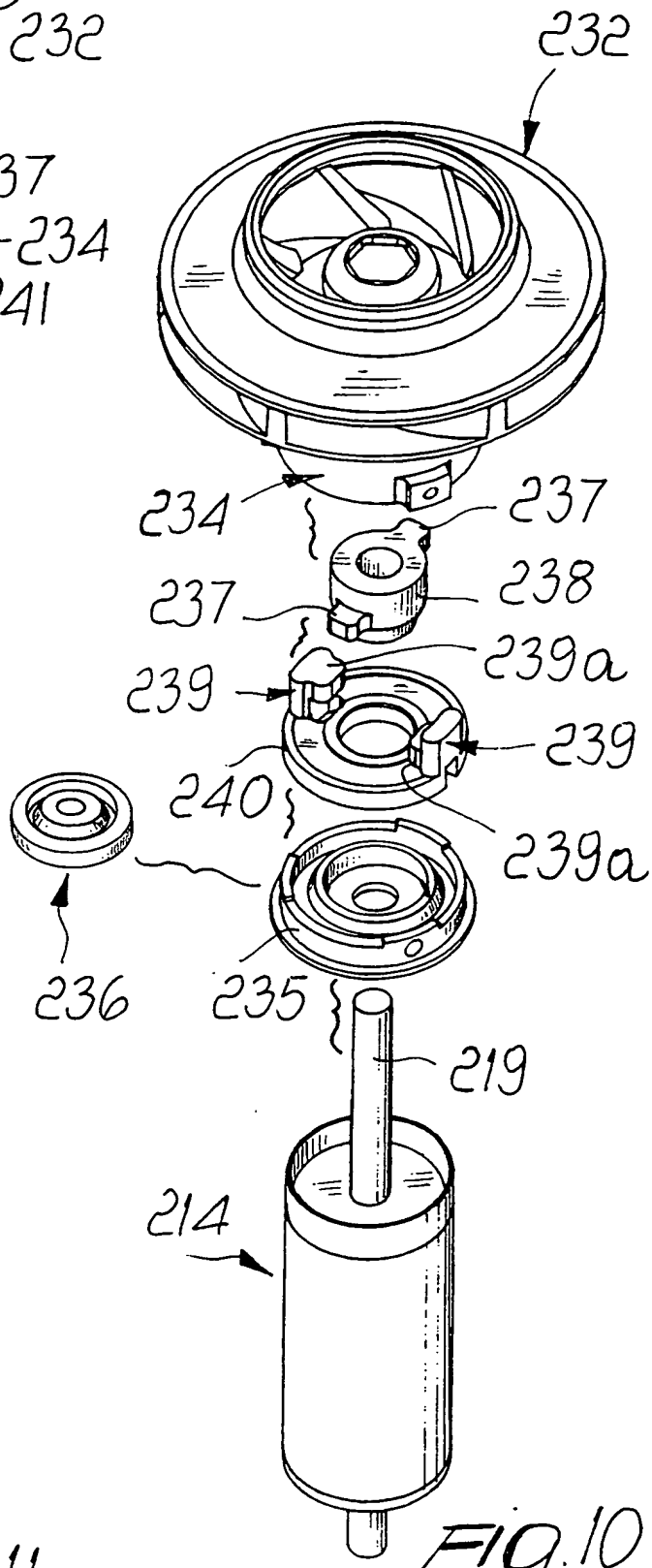

Fig. 10

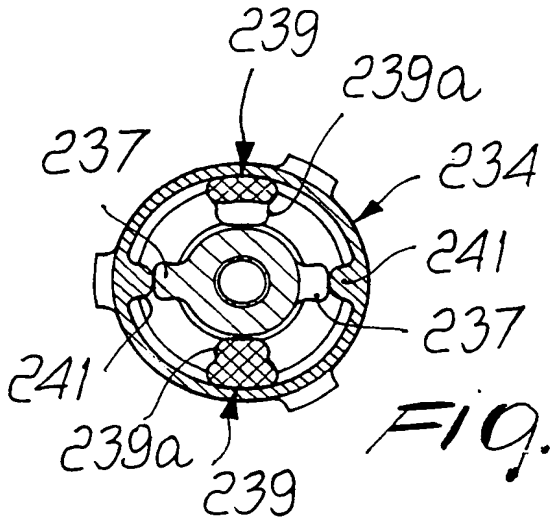

Fig. 11

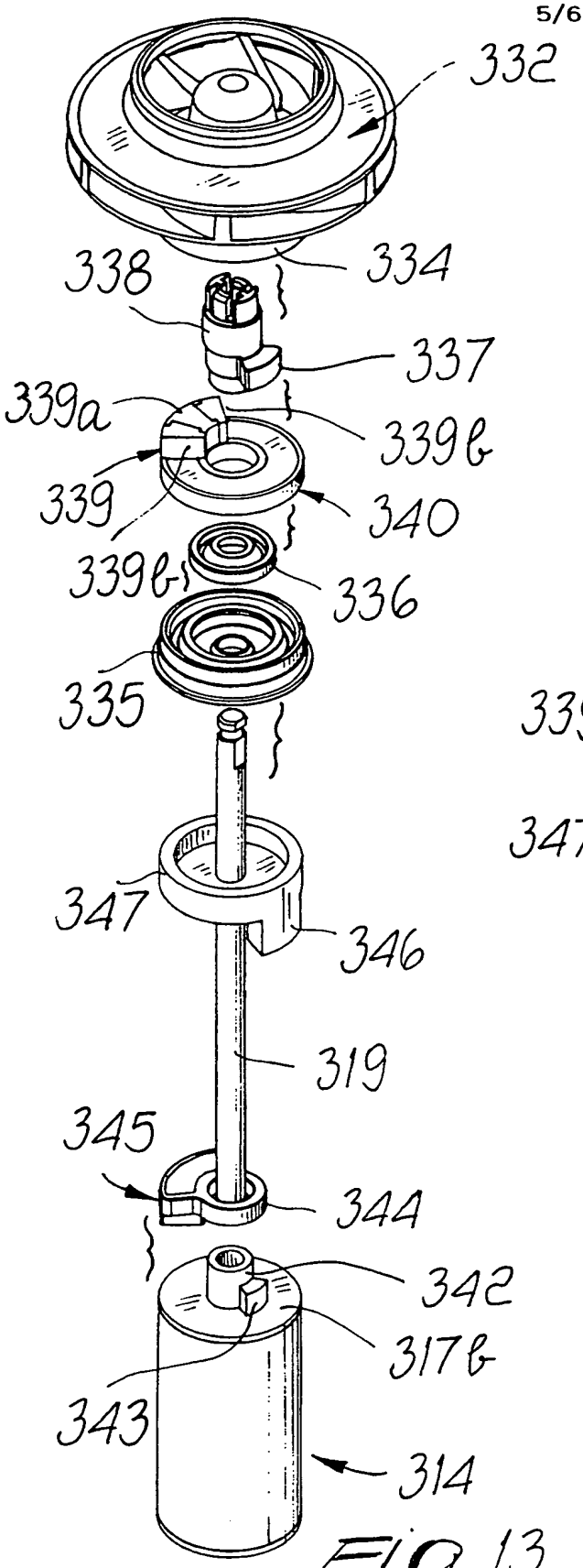
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Fig. 13

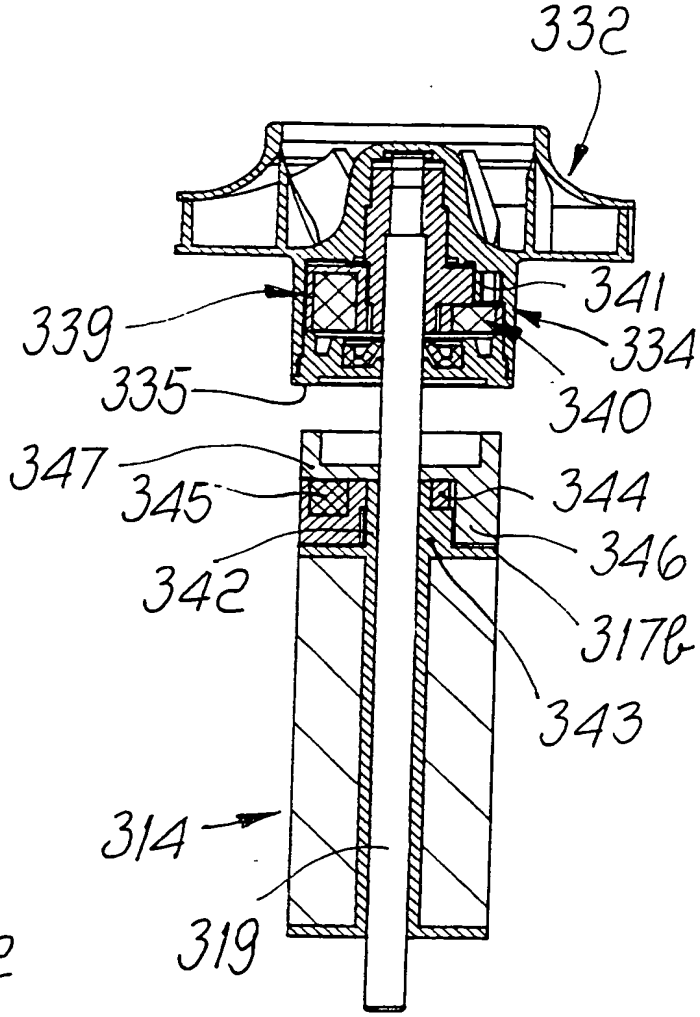
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Fig. 12

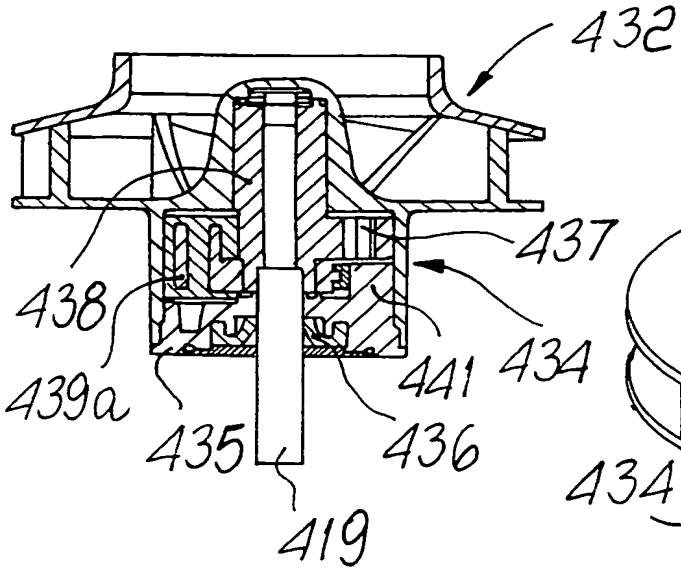

FIG. 14

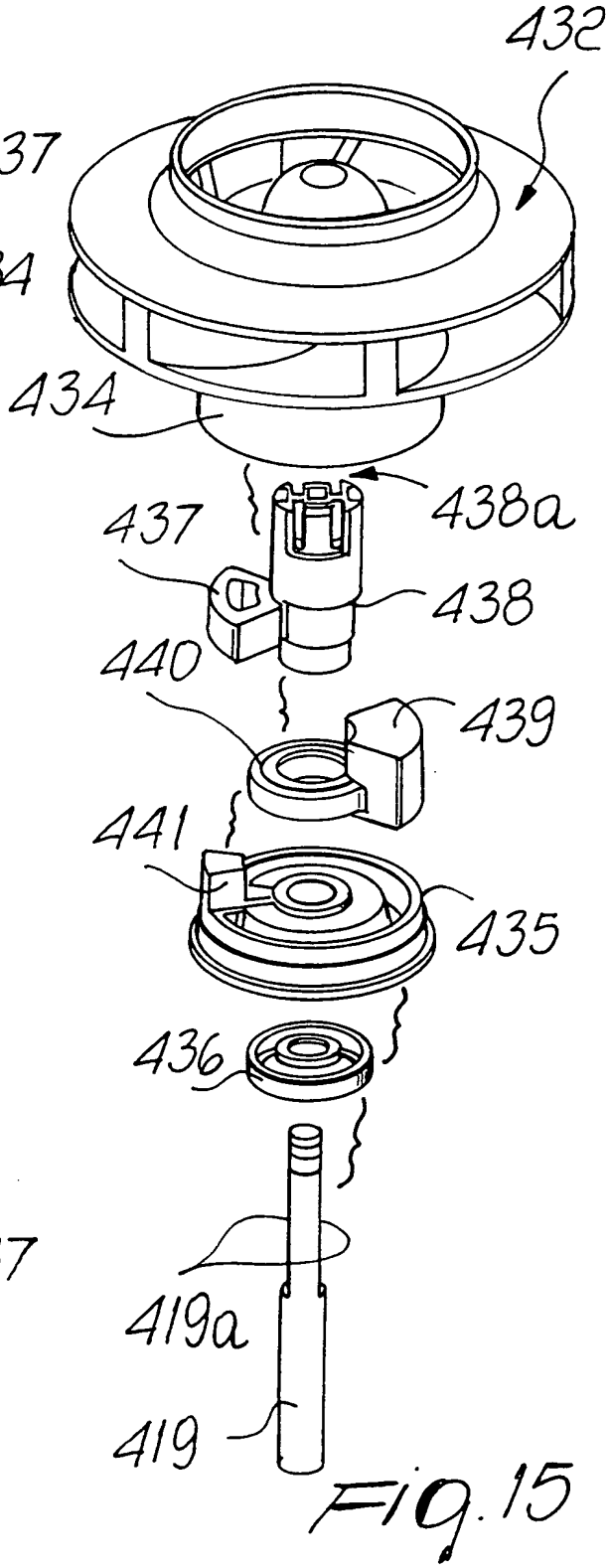

FIG. 15

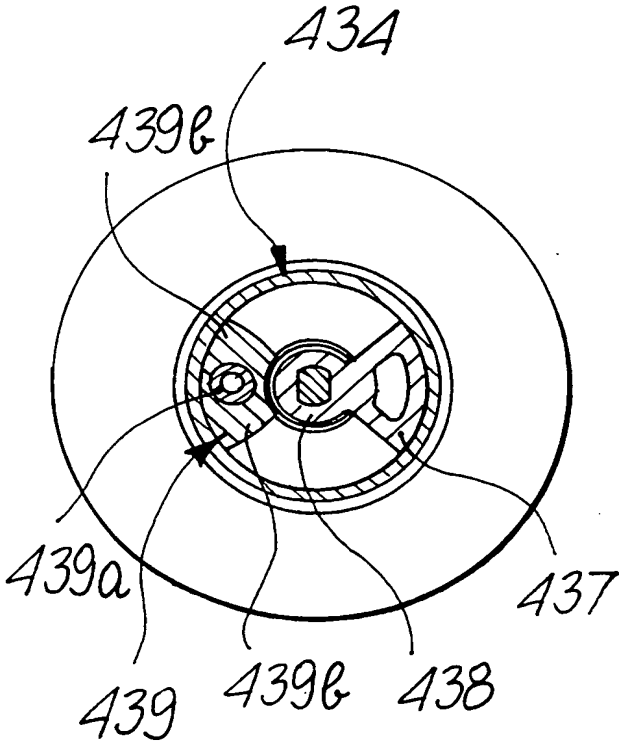

FIG. 16

INTERNATIONAL SEARCH REPORT

Int tional Application No
PCT/EP 99/01715

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H02K7/118 F16D3/02 F04D13/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H02K F16D F16H F04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	US 1 627 964 A (ROBERT M GALLOWAY) 10 May 1927 (1927-05-10) claims 1,2	1,2, 17-20,23

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
30 July 1999	06/08/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Ramos, H

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INTERNATIONAL SEARCH REPORT

Int ional Application No
PCT/EP 99/01715

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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